

## **AMENDMENTS TO THE CLAIMS**

This listing of claims will replace all prior versions, and listings, of claims in the application:

### **Listing of Claims:**

- 1        1. (Currently amended) A computer-implemented method of piggybacking  
2        a message invalidating cached data on a response to a data request, the method  
3        comprising:
  - 4              in a hierarchy of caches, passing a data request toward a data server;
  - 5              at an upstream cache, detecting the invalidation of a set of data cached on  
6        one or more downstream caches, including a first downstream cache, wherein the  
7        set of data includes no data requested in the data request;
    - 8              in a response to the data request, including an invalidation message to  
9        invalidate the set of data attached to with the response to the first downstream  
10      cache to invalidate the set of data; and  
11      forwarding the response including the invalidation message toward the  
12      first downstream cache.
- 1        2. (Original) The method of claim 1, further comprising:
  - 2              adding the set of data to a list of data to be invalidated on downstream  
3        caches.
- 1        3. (Original) The method of claim 2, further comprising:
  - 2              removing the set of data from the list of data after data request responses  
3        including messages to invalidate the set of data have been forwarded to each of  
4        the one or more downstream caches.

1           4. (Original) The method of claim 1, wherein the set of data includes data  
2       requested in the data request.

1           5. (Cancelled)

1           6. (Original) The method of claim 1, further comprising, in the first  
2       downstream cache:

3           receiving the response;

4           retrieving the message;

5           invalidating the set of data if the set of data is cached on the first  
6       downstream cache; and

7           forwarding the response toward a second downstream cache.

1           7. (Original) The method of claim 1, further comprising, in the first  
2       downstream cache:

3           receiving the response;

4           removing the message from the response;

5           invalidating the set of data if the set of data is cached on the first  
6       downstream cache; and

7           serving the response to a client that initiated the data request.

1           8. (Original) The method of claim 1, wherein said detecting comprises:  
2       receiving an invalidation message originated by the data server.

1           9. (Original) The method of claim 1, wherein said detecting comprises:  
2       receiving a manual notification of the invalidation of the set of data.

1           10. (Original) The method of claim 1, wherein the data request is initiated

2 by a first requestor and the response is targeted to a different requestor.

1 11. (Original) The method of claim 1, wherein the upstream cache is a  
2 cache local to the data server.

1 12. (Original) The method of claim 1, wherein the upstream cache and the  
2 first downstream cache are members of a cache cluster.

1 13. (Currently amended) A computer readable medium storing instructions  
2 that, when executed by a computer, cause the computer to perform a method of  
3 piggybacking a message invalidating cached data on a response to a data request,  
4 the method comprising:

5 in a hierarchy of caches, passing a data request toward a data server;  
6 at an upstream cache, detecting the invalidation of a set of data cached on  
7 one or more downstream caches, including a first downstream cache, wherein the  
8 set of data includes no data requested in the data request;

9 in a response to the data request, including an invalidation message to  
10 invalidate the set of data attached to with the response to the first downstream  
11 cache to invalidate the set of data; and

12 forwarding the response including the invalidation message toward the  
13 first downstream cache.

1 14. (Currently amended) An automated method of asynchronously  
2 communicating a side effect of a first data request in a response to a second data  
3 request, the method comprising:

4 in a computing environment comprising a data server and a plurality of  
5 caches, processing a first data request to produce a first response;  
6 identifying a side effect of the first data request;

7           communicating the side effect to a first cache upstream of one or more  
8   downstream caches;  
9           at the first cache:  
10          identifying a second response to a second data request;  
11          including notification of the side effect in the second response, wherein the  
12         side effect is unrelated to the second response; and  
13          forwarding the second response including the notification of the side effect  
14         toward a first downstream cache; and  
15          at the first downstream cache, applying the side effect.

1           15. (Original) The method of claim 14, wherein the side effect comprises  
2   invalidation of data cached on the first downstream cache.

1           16. (Original) The method of claim 14, wherein the side effect comprises  
2   propagation of cache configuration data.

1           17. (Original) The method of claim 14, wherein the side effect comprises a  
2   password.

1           18. (Original) The method of claim 14, wherein the side effect comprises  
2   an update to a cache program.

1           19. (Original) The method of claim 14, wherein the side effect comprises a  
2   replacement cache program.

1           20. (Original) The method of claim 14, wherein said applying the side  
2   effect at the first downstream cache comprises applying the side effect after  
3   forwarding the second response.

1           21. (Original) The method of claim 20, wherein said applying the side  
2 effect at the first downstream cache comprises applying the side effect before a  
3 specified event.

1           22. (Original) The method of claim 14, further comprising:  
2           at the first cache, tracking which of the one or more downstream caches  
3 has been notified of the side effect;  
4           wherein a downstream cache other than the first downstream cache  
5 receives notification of the side effect in a communication other than the second  
6 response.

1           23. (Currently amended) A computer readable medium storing instructions  
2 that, when executed by a computer, cause the computer to perform a method of  
3 asynchronously communicating a side effect of a first data request in a response to  
4 a second data request, the method comprising:  
5           in a computing environment comprising a data server and a plurality of  
6 caches, processing a first data request to produce a first response;  
7           identifying a side effect of the first data request;  
8           communicating the side effect to a first cache upstream of one or more  
9 downstream caches;  
10          at the first cache:  
11          identifying a second response to a second data request;  
12          including notification of the side effect in the second response, wherein the  
13 side effect is unrelated to the second response; and  
14          forwarding the second response including the notification of the side effect  
15 toward a first downstream cache; and  
16          at the first downstream cache, applying the side effect.

1           24. (Currently amended) A system for piggybacking notification of a side  
2 effect of a first data request in a response to a second data request, comprising:  
3           a data server configured to serve data in response to data requests;  
4           one or more downstream caches configured to cache the served data; and  
5           an upstream cache logically located between the data server and the one or  
6 more downstream caches, wherein the upstream cache is configured to include, in  
7 a response to one data request from the downstream cache, notification of a first  
8 side effect of a different data request, wherein the side effect is unrelated to the  
9 response to one data request.

1           25. (Original) The system of claim 24, wherein the upstream cache  
2 comprises:

3           a subscription table identifying each of the one or more downstream  
4 caches; and  
5           a list of side effects that the one or more downstream caches are to be  
6 notified of.

1           26. (Original) The system of claim 25, wherein the upstream cache is  
2 further configured to remove the first side effect from the list of side effects after  
3 each of the one or more downstream caches have been notified of the first side  
4 effect.

1           27. (Original) The system of claim 24, wherein the first side effect  
2 comprises the invalidation of a set of data.

1           28. (Original) The system of claim 24, wherein:  
2           the one or more downstream caches include a final downstream cache  
3           coupled to a client that initiated the one data request; and

4           the final downstream cache is configured to remove the notification of the  
5       first side effect of the different data request from the response before serving the  
6       response to the client.

1           29. (Original) The system of claim 24, wherein the upstream cache is a  
2       local cache of the data server.